Shenzhen Global Test Service Co.,Ltd.
1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong

FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No......:	**GTSR17080153-01**
FCC ID..... **:**	**2AHM7MBH539**
Compiled by (position+printed name+signature)..:	File administrators Jimmy Wang
Supervised by (position+printed name+signature)..:	Test Engineer Peter Xiao
Approved by (position+printed name+signature)..:	Manager Sam Wang
Date of issue.....:	Jun. 20, 2017

Representative Laboratory Name .:	**Shenzhen Global Test Service Co.,Ltd.**
Address .....:	1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong

Applicant's name.....:	**SHENZHEN YYW TECH.CO.,LTD.**
Address .....:	No.22 Chenhe Road, Madi, Liuyue, Henggang Town, Longgang District, Shenzhen, China

Test specification .....**:**	
Standard .....:	**FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.
Master TRF.....:	Dated 2014-12

Test item description .....:	Stereo earphone with bluetooth
Trade Mark .....:	MAGNAVOX
Manufacturer .....:	**SHENZHEN YYW TECH.CO.,LTD.**
Model/Type reference.....:	MBH539
Listed Models .....:	/
Modulation Type .....:	GFSK,Π/4DQPSK,8DPSK
Operation Frequency.....:	From 2402MHz to 2480MHz
Hardware Version .....:	HMD_X11
Software Version .....:	V1.0
Rating .....:	DC 3.7V
Result.....:	**PASS**

T E S T R E P O R T

Test Report No. :	**GTSR17080153-01**	Jun. 20, 2017 Date of issue

Equipment under Test	:	Stereo earphone with bluetooth
Model /Type	:	MBH539
Listed Models	:	/
Applicant	:	**SHENZHEN YYW TECH.CO.,LTD.**
Address	:	No.22 Chenhe Road, Madi, Liuyue, Henggang Town, Longgang District, Shenzhen, China
Manufacturer	:	**SHENZHEN YYW TECH.CO.,LTD.**
Address	:	No.22 Chenhe Road, Madi, Liuyue, Henggang Town, Longgang District, Shenzhen, China

Test Result:	**PASS**

Contents

1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices
DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	Jun. 10, 2017
Testing commenced on	:	Jun. 10, 2017
Testing concluded on	:	Jun. 20, 2017

2.2. Product Description

Name of EUT	Stereo earphone with bluetooth
Trade Mark:	/
Model Number	MBH535
List Model:	/
FCC ID	2AHM7MBH539
Antenna Type	Internal
Bluetooth FCC Operation frequency	2402MHz-2480MHz
Bluetooth Modulation	GFSK,8DPSK,π/4DQPSK
Bluetooth	BT V4.1 EDR
Antenna gain	-0.64dBi

2.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	230V / 50 Hz	○	120V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 3.7V

2.4. Short description of the Equipment under Test (EUT)

This is a Stereo earphone with bluetooth.

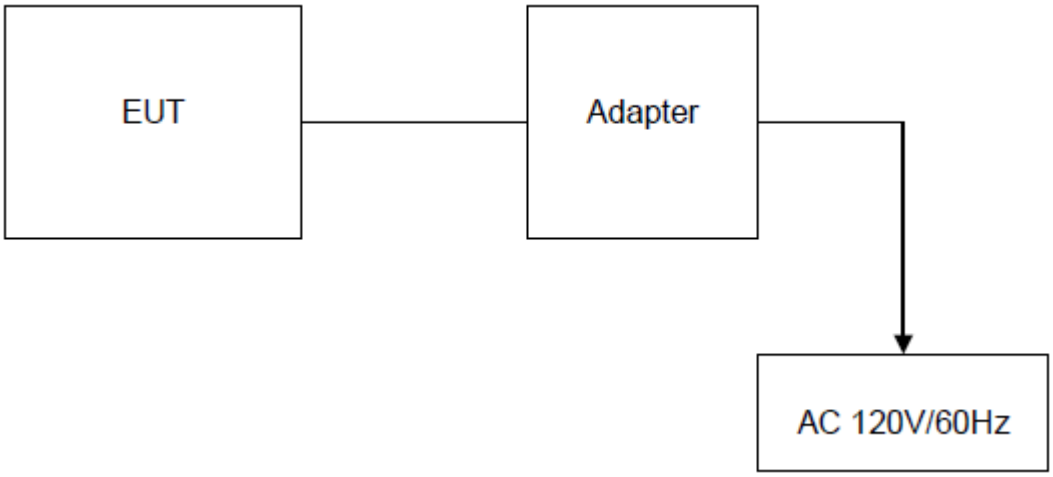
For more details, refer to the user's manual of the EUT.

2.5. EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT. Channel 00/38/78 was selected to test.

Channel	Frequency(MHz)	Channel	Frequency(MHz)
00	**2402**	40	2442
01	2403	41	2443
02	2404	42	2444
03	2405	43	2445
04	2406	44	2446
05	2407	45	2447
06	2408	46	2448
07	2409	47	2449
08	2410	48	2450
09	2411	49	2451
10	2412	50	2452
11	2413	51	2453
12	2414	52	2454
13	2415	53	2455
14	2416	54	2456
15	2417	55	2457
16	2418	56	2458
17	2419	57	2459
18	2420	58	2460
19	2421	59	2461
20	2422	60	2462
21	2423	61	2463
22	2424	62	2464
23	2425	63	2465
24	2426	64	2466
25	2427	65	2467
26	2428	66	2468
27	2429	67	2469
28	2430	68	2470
29	2431	69	2471
30	2432	70	2472
31	2433	71	2473
32	2434	72	2474
33	2435	73	2475
34	2436	74	2476
35	2437	75	2477
36	2438	76	2478
37	2439	77	2479
38	**2440**	**78**	**2480**
39	2441		

2.6. Block Diagram of Test Setup



2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AHM7MBH539** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - Supplied by the lab

○	Adapter	M/N:	AK733KX
		Manufacturer:	OPPO

2.9. Modifications

No modifications were implemented to meet testing criteria.

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.
1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong

Shenzhen CTL Testing Technology Co., Ltd.
1/F.-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, Guangdong, China

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 964637

Shenzhen Global Test Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 964637, Jul 24, 2015.

CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2018.

FCC-Registration No.: 970318

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 970318, December 19, 2013.

3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4. Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density	-/-	-/-	-/-	-/-	☐	☐	☒	☐	Not applicable for FHSS
§15.247(a)(1)	Carrier Frequency separation	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Middle	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Number of Hopping channels	GFSK 8DPSK	☒ Full	GFSK 8DPSK	☒ Full	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Middle	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Spectrum bandwidth of a FHSS system 20dB bandwidth	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies
§15.247(d)	Band edge compliance conducted	GFSK 8DPSK	☒ Lowest ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	GFSK 8DPSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☐	☐	☒	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report
4. For π/4 QPSK its same modulation type with 8-DPSK, and based exploratory test, there is no significant difference of that two types test result, so except output power, all other items final test were only performed with the worse case 8-DPSK and GFSK.

3.5. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.6. Equipments Used during the Test

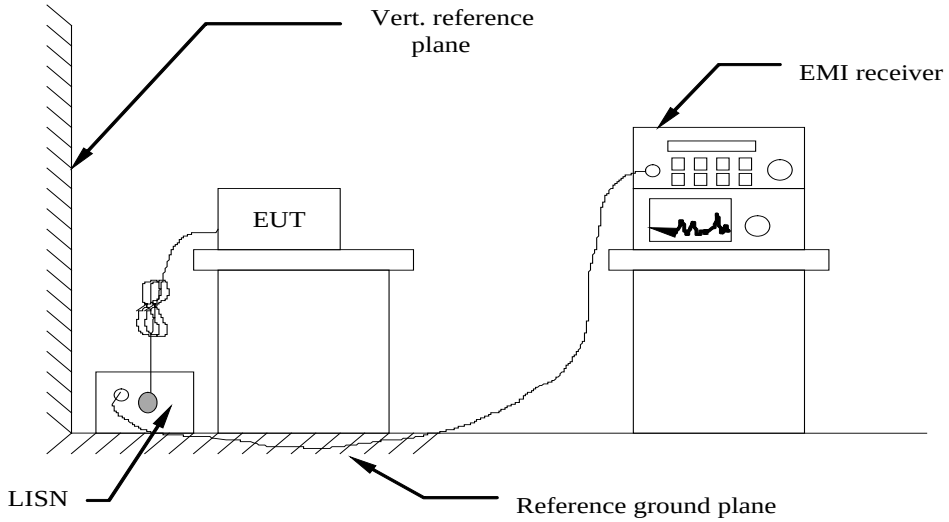
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2017/05/28	2018/05/27
LISN	R&S	ESH2-Z5	893606/008	2017/05/27	2018/05/26
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2017/06/02	2018/06/01
EMI Test Receiver	R&S	ESCI	101102	2016/06/26	2017/06/25
Spectrum Analyzer	Agilent	N9020A	MY48010425	2017/06/17	2018/06/16
Controller	EM Electronics	Controller EM 1000	N/A	2017/05/21	2018/05/20
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2017/05/19	2018/05/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2017/05/19	2018/05/18
Amplifier	Agilent	8349B	3008A02306	2017/05/19	2018/05/18
Amplifier	Agilent	8447D	2944A10176	2017/05/19	2018/05/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2017/05/20	2018/05/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2017/05/20	2018/05/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2017/05/20	2018/05/19
RF Cable	HUBER+SUHNER	RG214	N/A	2017/05/20	2018/05/19
Data acquisition card	Agilent	U2531A	TW53323507	2017/05/20	2018/05/19
Power Sensor	Agilent	U2021XA	MY5365004	2017/05/20	2018/05/19

Note: The Cal.Interval was one year.

4. TEST CONDITIONS AND RESULTS

4.1. AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013.
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013.
4 The EUT received DC 5V power, the adapter received AC120V/60Hz or AC 240V/50Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

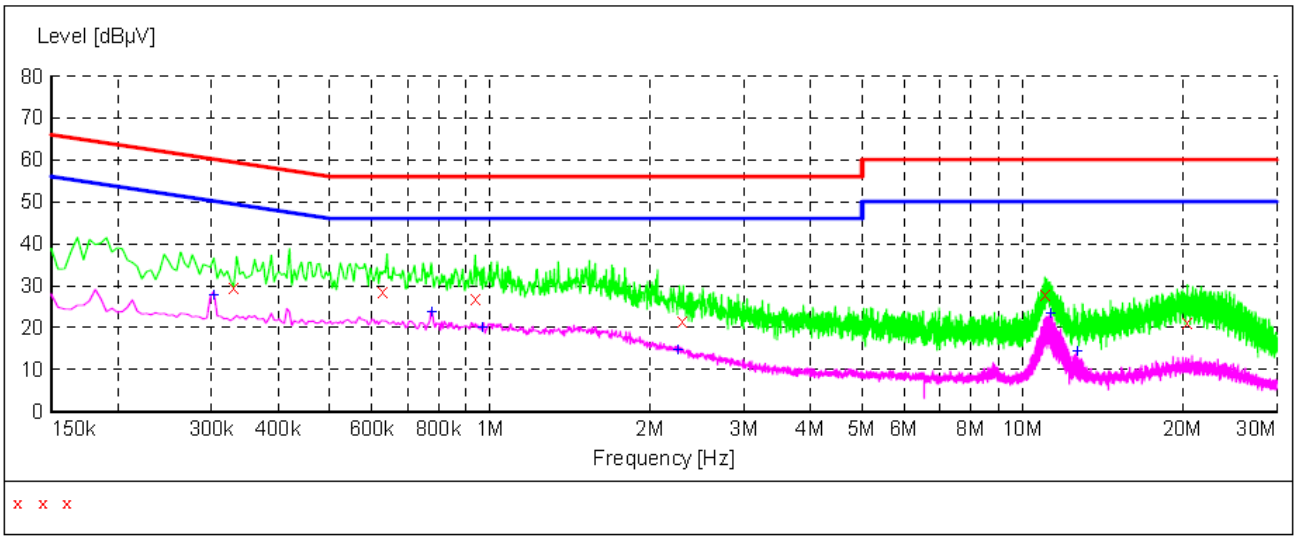
For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

TEST RESULTS

Remark: We measured Conducted Emission at GFSK, π/4 DQPSK and 8DPSK mode in AC 120V/60Hz and AC 240V/50Hz, the worst case was recorded .

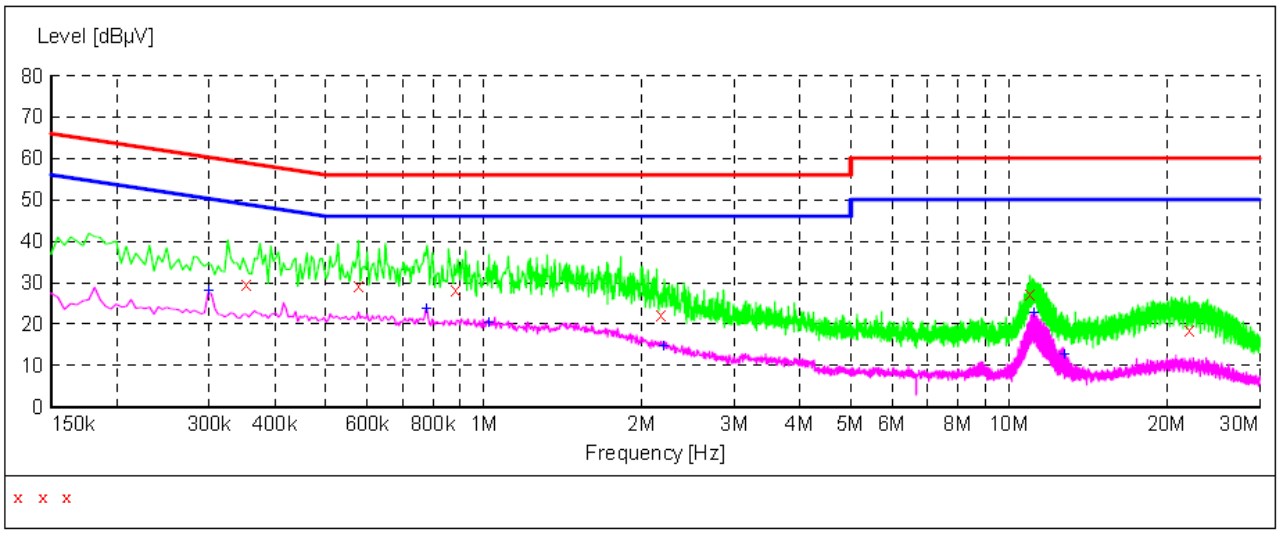
Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	L



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.330000	29.50	9.9	60	30.0	QP	L1	GND
0.631500	28.60	9.7	56	27.4	QP	L1	GND
0.942000	27.00	9.6	56	29.0	QP	L1	GND
2.301000	21.60	9.5	56	34.4	QP	L1	GND
11.008500	27.90	8.7	60	32.1	QP	L1	GND
20.386500	21.30	9.0	60	38.7	QP	L1	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.303000	27.70	9.9	50	22.5	AV	L1	GND
0.775500	23.70	9.7	46	22.3	AV	L1	GND
0.964500	20.00	9.6	46	26.0	AV	L1	GND
2.251500	14.50	9.5	46	31.5	AV	L1	GND
11.251500	23.20	8.7	50	26.8	AV	L1	GND
12.642000	14.20	8.5	50	35.8	AV	L1	GND

Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	N



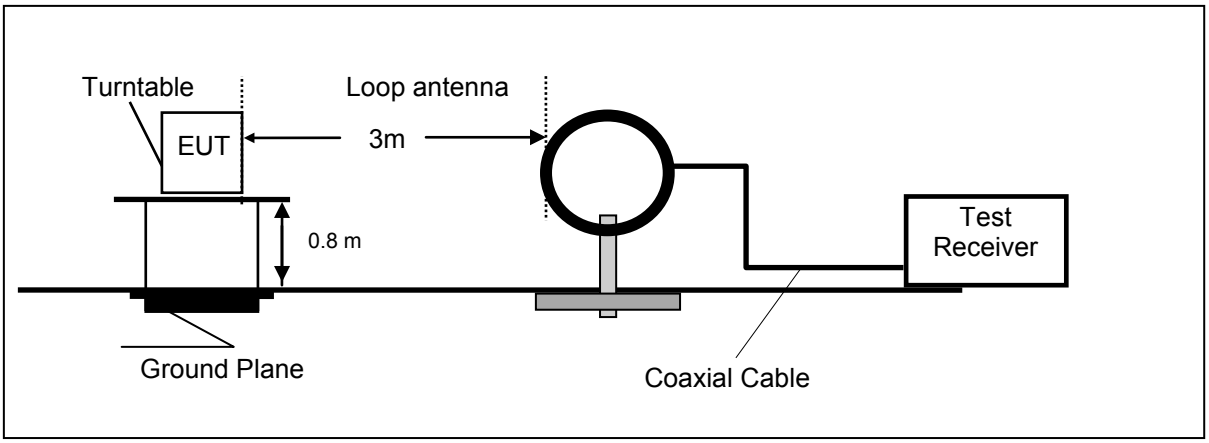
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.352500	29.70	9.9	59	29.2	QP	N	GND
0.577500	29.20	9.7	56	26.8	QP	N	GND
0.888000	28.20	9.6	56	27.8	QP	N	GND
2.170500	22.20	9.5	56	33.8	QP	N	GND
10.981500	27.50	8.7	60	32.5	QP	N	GND
22.074000	18.50	9.0	60	41.5	QP	N	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.298500	27.90	9.9	50	22.4	AV	N	GND
0.775500	23.70	9.7	46	22.3	AV	N	GND
1.023000	20.20	9.6	46	25.8	AV	N	GND
2.202000	14.70	9.5	46	31.3	AV	N	GND
11.161500	22.50	8.7	50	27.5	AV	N	GND
12.705000	12.70	8.5	50	37.3	AV	N	GND

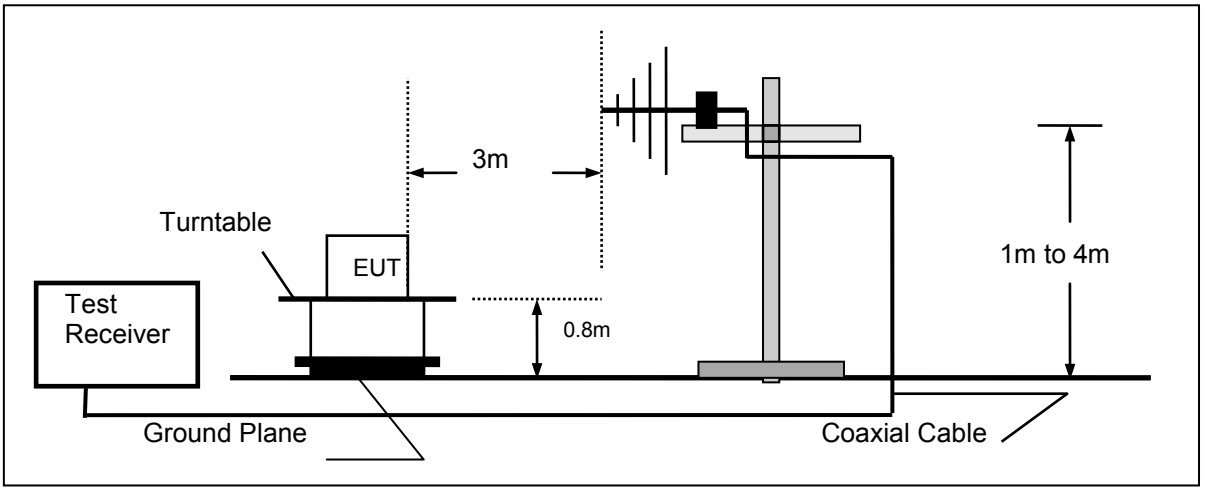
4.2. Radiated Emission

TEST CONFIGURATION

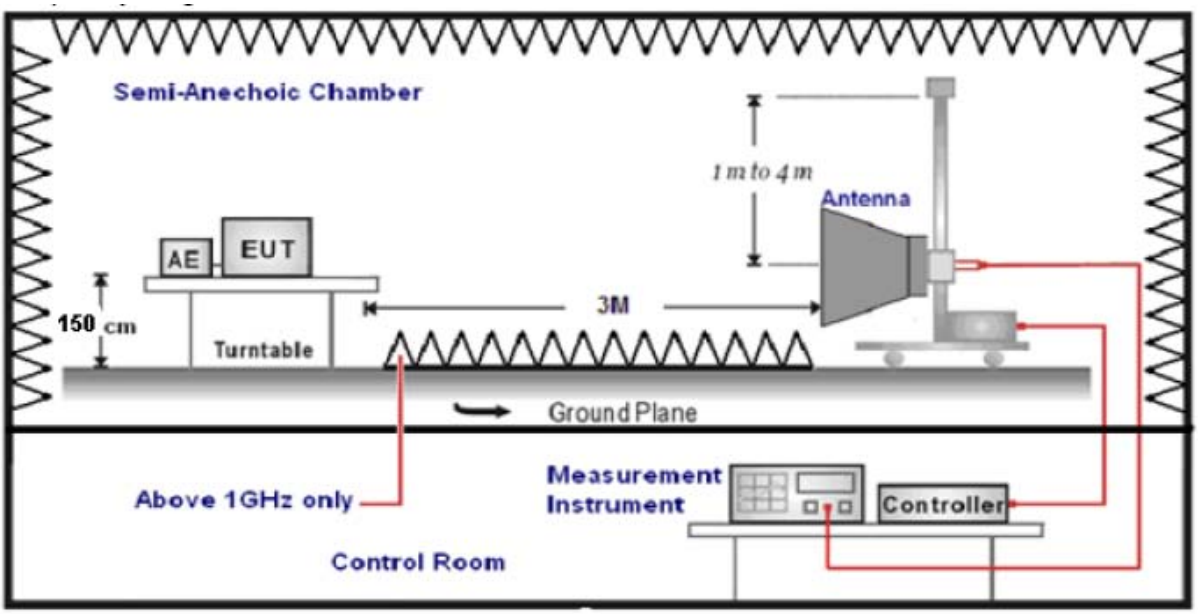
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.
The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST RESULTS

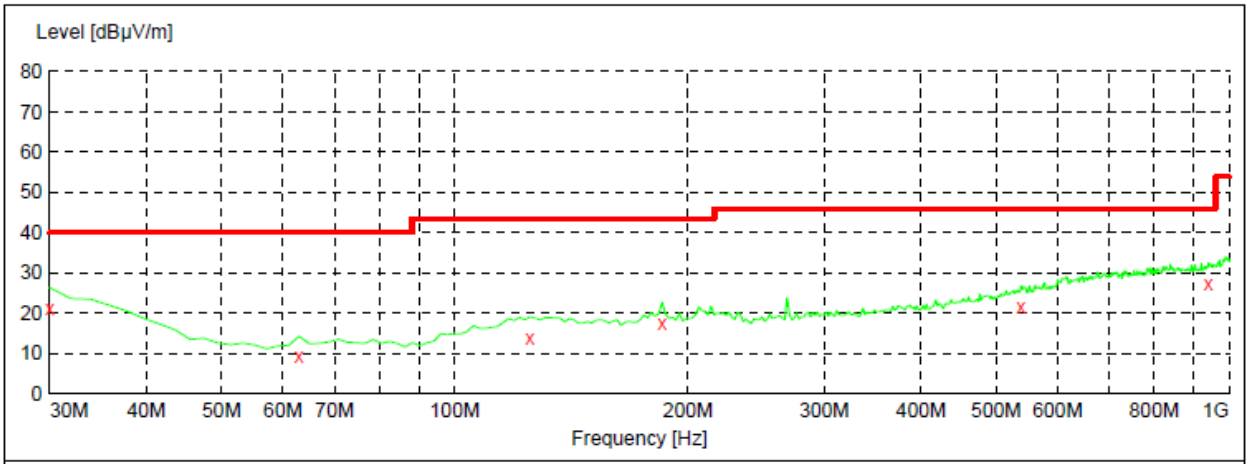
Remark: We measured Radiated Emission at GFSK, π/4 DQPSK and 8DPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK mode.
Test site: Shenzhen CTL Testing Technology Co., Ltd

For 9 KHz-30MHz

Frequency (MHz)	Corrected Reading (dBuV/m)@3m	FCC Limit (dBuV/m) @3m	Margin (dB)	Detector	Result
0.41	48.36	95.35	46.78	QP	PASS
0.97	39.67	67.87	30.67	QP	PASS
6.12	40.21	69.54	29.33	QP	PASS
21.34	38.76	69.54	30.78	QP	PASS

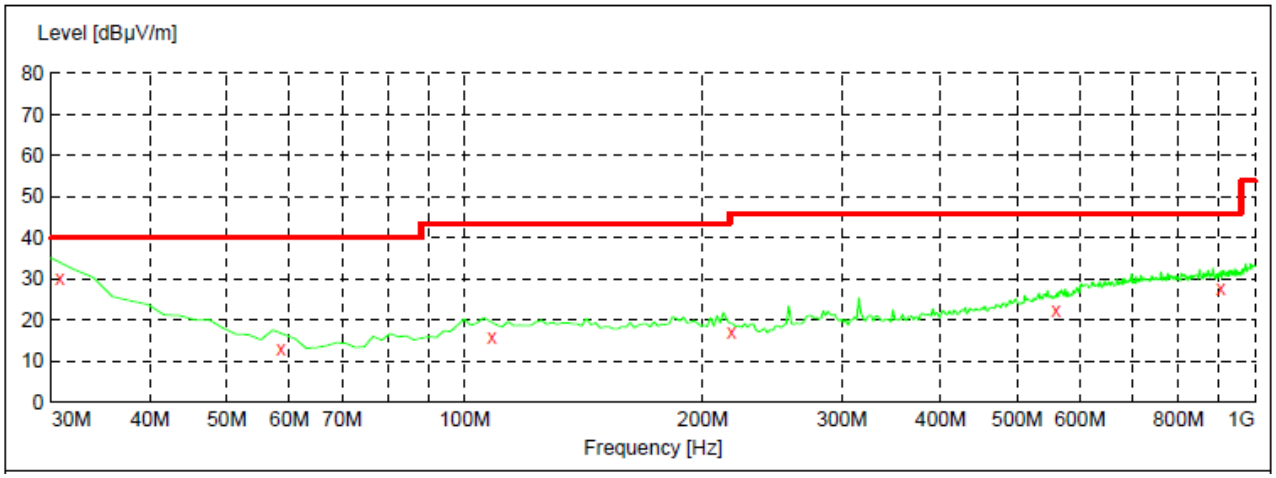
For 30MHz-1GHz

Horizontal



Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	21.30	22.1	40.0	18.7	QP	100	84.0	HORIZONTAL
62.980000	9.70	8.1	40.0	30.3	QP	100	92.0	HORIZONTAL
125.060000	14.00	15.3	43.5	29.5	QP	100	154.0	HORIZONTAL
185.200000	18.70	14.6	43.5	24.8	QP	100	169.0	HORIZONTAL
538.280000	21.80	21.5	46.0	24.2	QP	100	207.0	HORIZONTAL
939.860000	28.50	27.1	46.0	17.5	QP	100	272.0	HORIZONTAL

Vertical



Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	30.00	22.1	40.0	10.0	QP	100	46.0	VERTICAL
57.160000	13.60	7.9	40.0	26.4	QP	100	81.0	VERTICAL
105.660000	17.60	12.5	43.5	25.9	QP	100	102.0	VERTICAL
212.360000	18.20	14.5	43.5	25.3	QP	100	216.0	VERTICAL
546.040000	22.40	21.7	46.0	23.6	QP	100	118.0	VERTICAL
883.600000	28.60	26.2	46.0	17.4	QP	100	321.0	VERTICAL

For 1GHz to 25GHz

Frequency(MHz):				2402			Polarity:			HORIZONTAL		
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
1	4804.00	49.12	PK	74.00	24.88	1.00 H	62	47.22	31.42	6.98	36.5	1.90
1	4804.00	40.55	AV	54.00	13.45	1.00 H	62	38.65	31.42	6.98	36.5	1.90
2	7206.00	49.23	PK	74.00	24.77	1.00 H	207	38.62	37.03	8.87	35.3	10.60
2	7206.00	--	AV	--	--	--	--	--	--	--	--	--

Frequency(MHz):				2402			Polarity:			VERTICAL		
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
1	4804.00	47.12	PK	74.00	26.88	1.00 V	77	45.22	31.42	6.98	36.5	1.90
1	4804.00	38.97	AV	54.00	15.03	1.00 V	77	37.07	31.42	6.98	36.5	1.90
2	7206.00	47.09	PK	74.00	26.91	1.00 V	266	36.49	37.03	8.87	35.3	10.60
2	7206.00	--	AV	--	--	--	--	--	--	--	--	--

Frequency(MHz):				2440			Polarity:			HORIZONTAL		
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
1	4880.00	48.54	PK	74.00	25.46	1.00 H	128	46.48	30.98	7.58	36.5	2.06
1	4880.00	40.11	AV	54.00	13.89	1.00 H	128	38.05	30.98	7.58	36.5	2.06
2	7320.00	48.43	PK	74.00	25.57	1.00 H	189	37.51	37.66	8.56	35.3	10.92
2	7320.00	--	AV	--	--	--	--	--	--	--	--	--

Frequency(MHz):				2440			Polarity:			VERTICAL		
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
1	4880.00	50.15	PK	74.00	23.85	1.00 V	96	48.09	30.98	7.58	36.5	2.06
1	4880.00	41.23	AV	54.00	12.77	1.00 V	96	39.17	30.98	7.58	36.5	2.06
2	7320.00	50.29	PK	74.00	23.71	1.00 V	254	39.37	37.66	8.56	35.3	10.92
2	7320.00	--	AV	--	--	--	--	--	--	--	--	--

Frequency(MHz):				2480			Polarity:			HORIZONTAL		
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
1	4960.00	49.55	PK	74.00	24.45	1.00 H	58	46.48	31.47	7.80	36.2	3.07
1	4960.00	40.05	AV	54.00	13.95	1.00 H	58	36.98	31.47	7.80	36.2	3.07
2	7440.00	49.31	PK	74.00	24.69	1.00 H	209	37.57	38.32	8.72	35.3	11.74
2	7440.00	--	AV	--	--	--	--	--	--	--	--	--

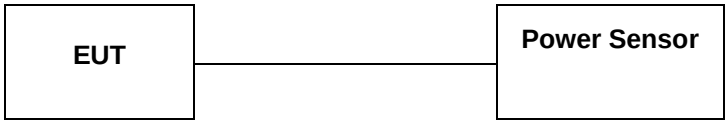
Frequency(MHz):				2480			Polarity:			VERTICAL		
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
1	4960.00	50.89	PK	74.00	23.11	1.00 V	88	47.82	31.47	7.80	36.2	3.07
1	4960.00	40.72	AV	54.00	13.28	1.00 V	88	37.65	31.47	7.80	36.2	3.07
2	7440.00	50.66	PK	74.00	23.34	1.00 V	149	38.92	38.32	8.72	35.3	11.74
2	7440.00	--	AV	--	--	--	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to ANSI C63.10:2013 Maximum peak conducted output power for HFSS devices:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.
The maximum Average conducted output power may be measured using a wideband RF power meter with a thermocouple derector or equivalent. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

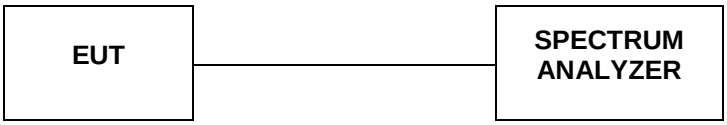
TEST RESULTS

Type	Channel	Peak Output power (dBm)	Average Output power (dBm)	Limit (dBm)	Result
GFSK	00	3.75	3.12	30	Pass
	38	3.58	2.87		
	78	3.12	2.52		
π/4DQPSK	00	3.29	2.63	21	Pass
	38	3.05	2.47		
	78	2.50	2.03		
8DPSK	00	3.24	2.58	21	Pass
	38	3.03	2.46		
	78	2.45	1.84		

Note: The test results including the cable lose.

4.4. 20dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

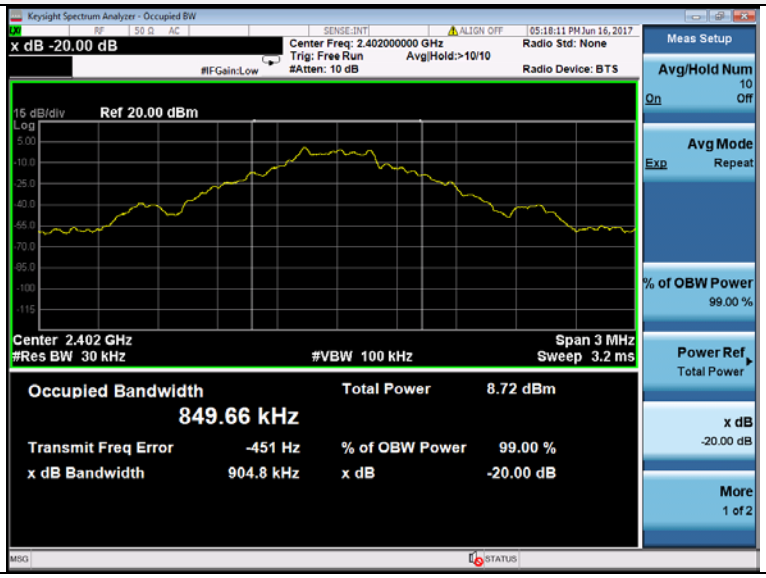
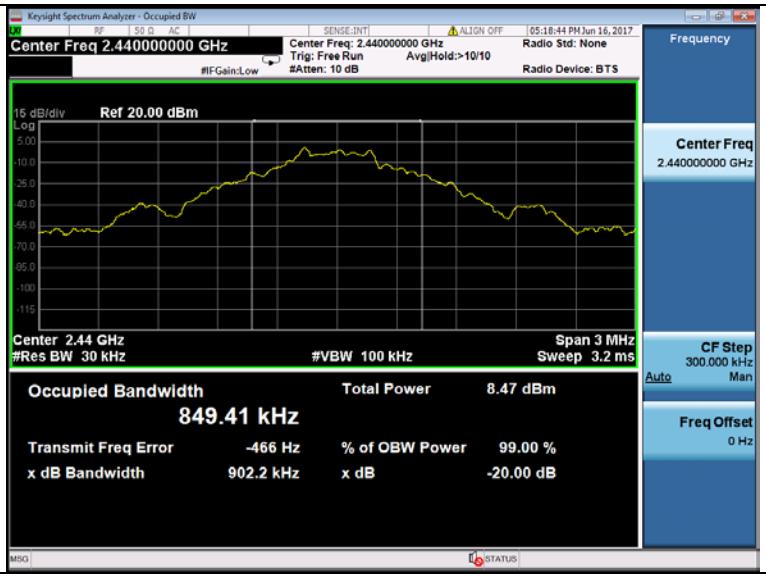
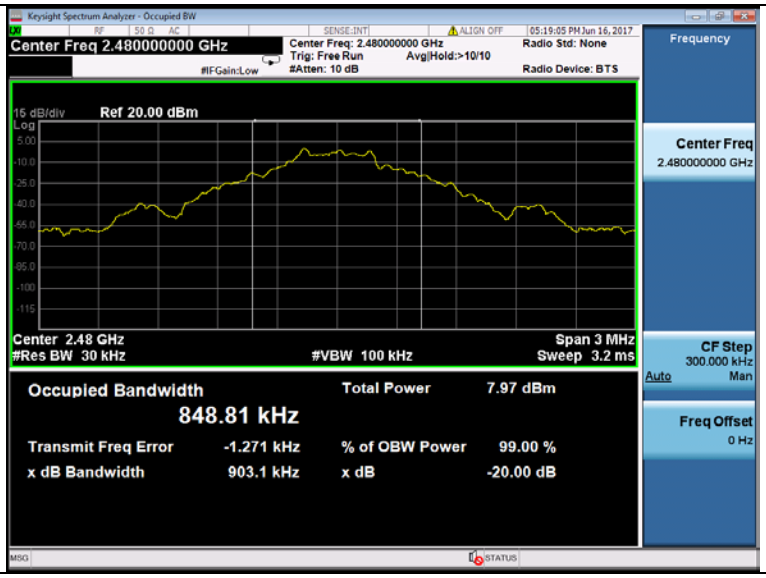
The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30KHz and VBW=100KHz.
The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

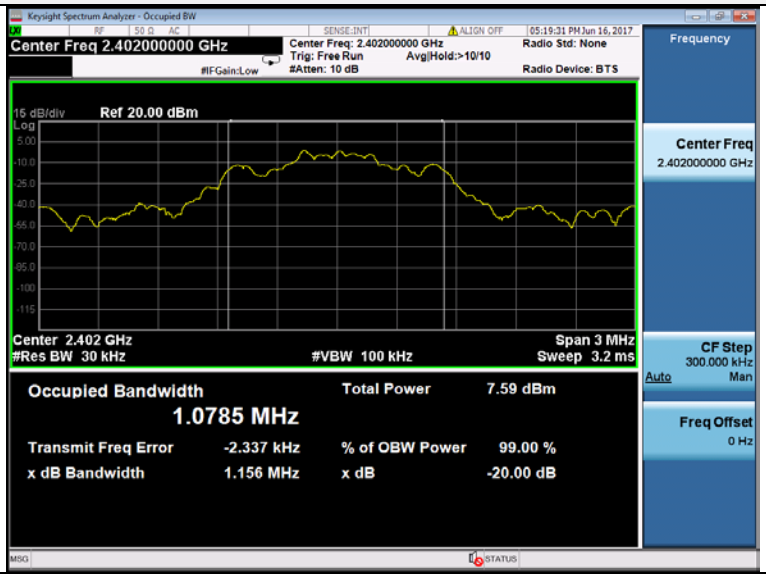
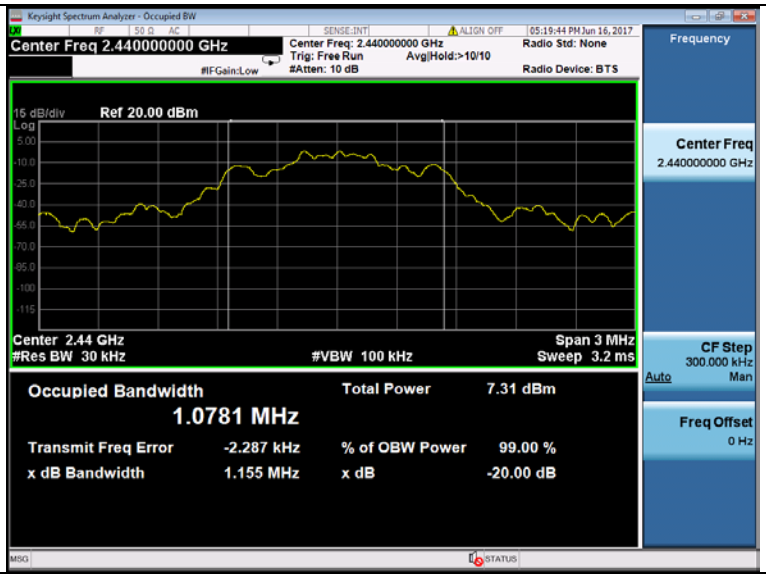
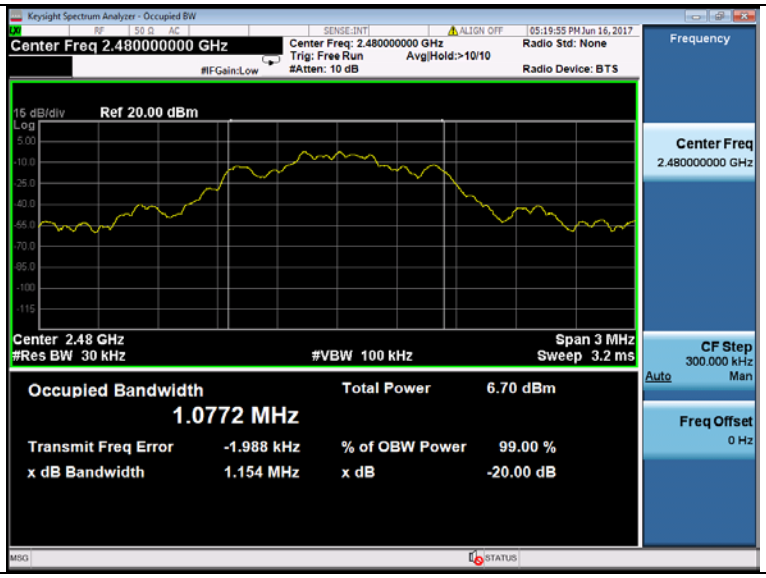
LIMIT

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwith.

TEST RESULTS

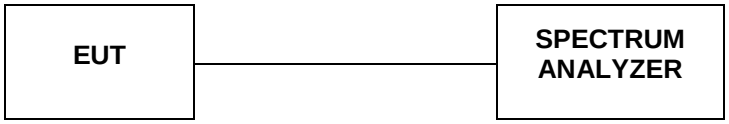
Modulation	Channel	20dB bandwidth (MHz)	Result
GFSK	CH00	0.9048	Pass
	CH38	0.9022	
	CH78	0.9031	
8DSPSK	CH00	1.156	
	CH38	1.155	
	CH78	1.154	

GFSK Modulation

CH00

CH38

CH78

8DSPSK Modulation

CH00

CH38

CH78

4.5. Frequency Separation

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30KHz and VBW=100KHz.

LIMIT

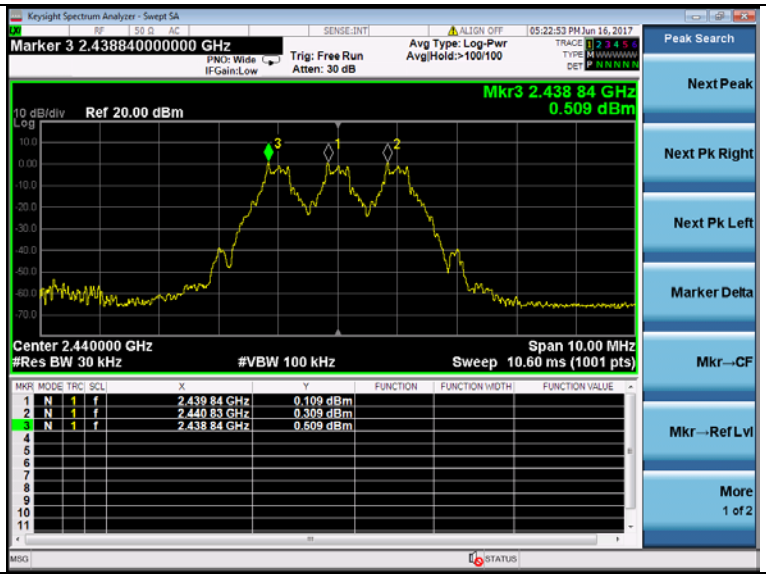
According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST RESULTS

4.5.1 GFSK Test Mode

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH38	1.000	0.9022	Pass
	CH39			
8DPSK	CH38	1.000	0.770	Pass
	CH39			

Remark: We have tested all mode at high, middle and low channel, and recorded worst case at middle


Keysight Spectrum Analyzer - Swept SA
Marker 3 2.438840000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
05:22:53 PM Jun 16, 2017
Mkr3 2.438 84 GHz
0.509 dBm
10 dB/div
Log
Ref 20.00 dBm
Center 2.440000 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 10.00 MHz
Sweep 10.60 ms (1001 pts)
1 N 1 f 2.439 84 GHz 0.109 dBm
2 N 1 f 2.440 83 GHz 0.309 dBm
3 N 1 f 2.438 84 GHz 0.509 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

GFSK


Keysight Spectrum Analyzer - Swept SA
Marker 3 2.438840000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
05:24:08 PM Jun 16, 2017
Mkr3 2.438 84 GHz
-1.834 dBm
10 dB/div
Log
Ref 20.00 dBm
Center 2.440000 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 10.00 MHz
Sweep 10.60 ms (1001 pts)
1 N 1 f 2.439 84 GHz -2.243 dBm
2 N 1 f 2.440 83 GHz -2.049 dBm
3 N 1 f 2.438 84 GHz -1.834 dBm
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More
1 of 3

8DPSK

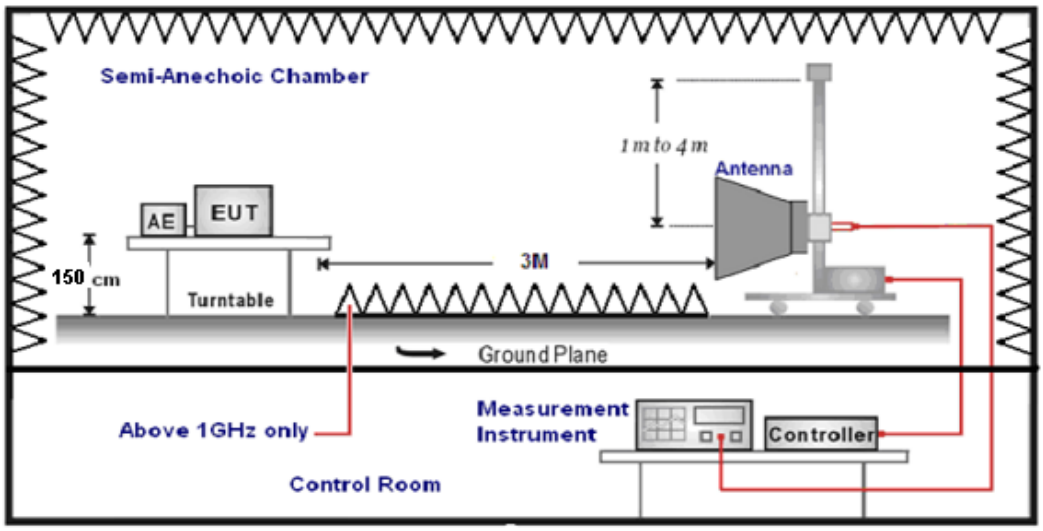
4.6. Band Edge Compliance of RF Emission

TEST REQUIREMENT

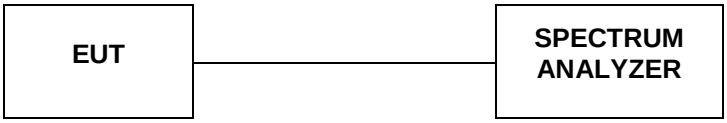
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION

For Radiated



For Conducted



TEST PROCEDURE

1. The EUT was placed on a turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

LIMIT

Below -20dB of the highest emission level in operating band.
Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

TEST RESULTS

Remark: we measured all conditions(DH1,DH3,DH5) and recorded worst case at DH1.
Test site: Shenzhen CTL Testing Technology Co., Ltd.

4.6.1 For Radiated Bandedge Measurement

Remark: we tested radiated bandedge at both hopping and no-hopping modes,recorded worst case at no-hopping mode

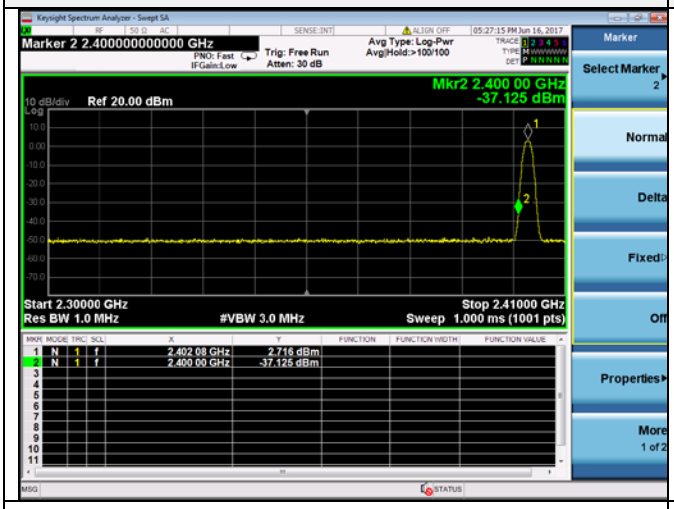
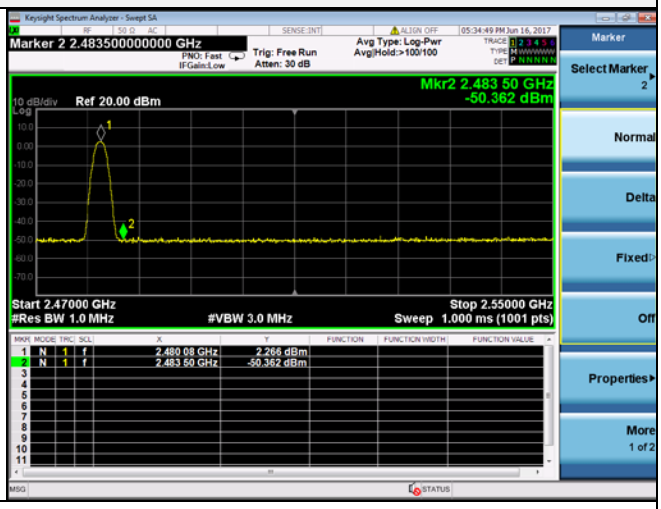
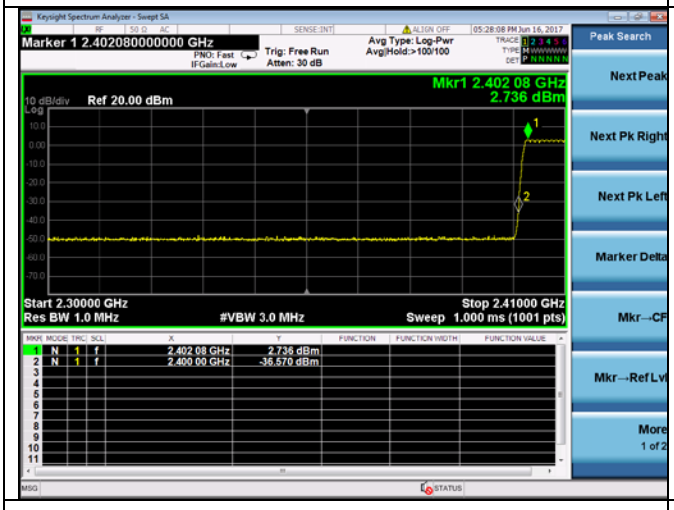
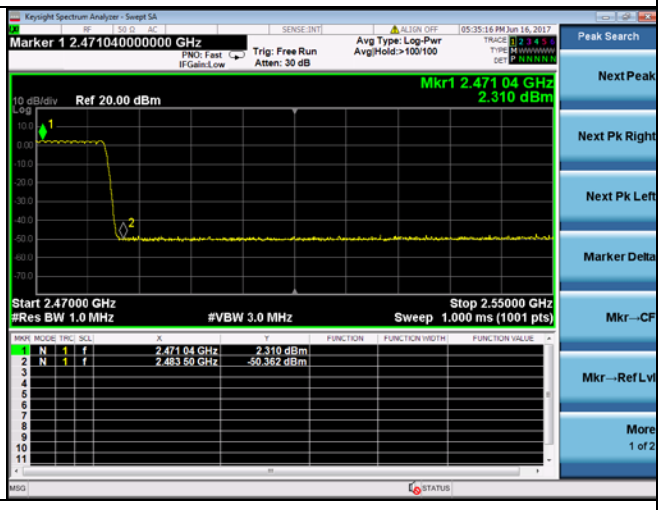
GFSK

Frequency(MHz):			**2402**			**Polarity:**			**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390.00	50.27	PK	74.00	23.73	1.00	164	55.58	27.49	3.32	36.12	-5.31
2390.00	40.54	AV	54.00	13.46	1.00	164	45.85	27.49	3.32	36.12	-5.31
Frequency(MHz):			**2402**			**Polarity:**			**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390.00	48.96	PK	74.00	25.04	1.00	204	54.27	27.49	3.32	36.12	-5.31
2390.00	40.33	AV	54.00	13.67	1.00	204	45.64	27.49	3.32	36.12	-5.31
Frequency(MHz):			**2480**			**Polarity:**			**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.50	49.76	PK	74.00	24.24	1.00	91	55.48	27.45	3.38	36.55	-5.72
2483.50	38.45	AV	54.00	15.55	1.00	91	44.17	27.45	3.38	36.55	-5.72
Frequency(MHz):			**2480**			**Polarity:**			**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.50	50.68	PK	74.00	23.32	1.00	285	56.40	27.45	3.38	36.55	-5.72
2483.50	40.49	AV	54.00	13.51	1.00	285	46.21	27.45	3.38	36.55	-5.72

4.6.2 For Conducted Bandedge Measurement

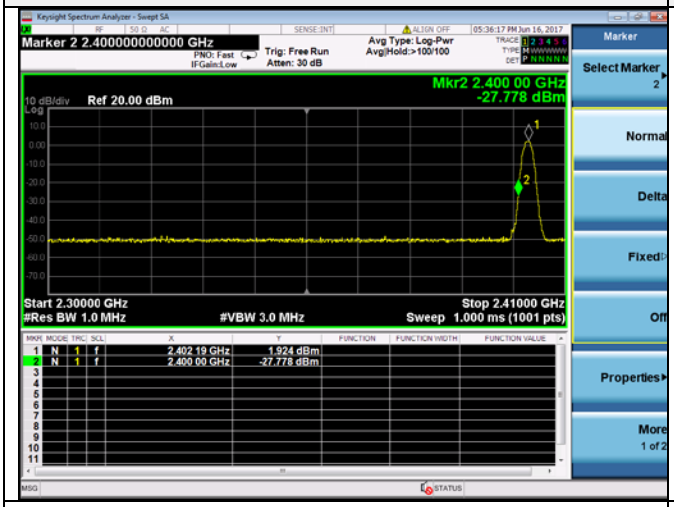
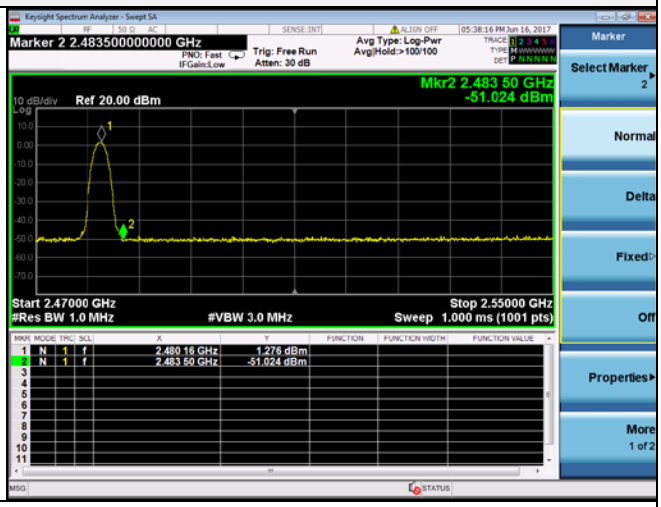
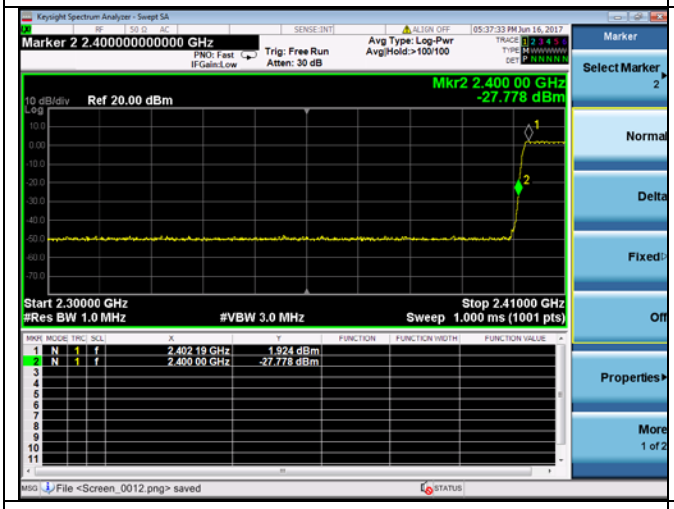
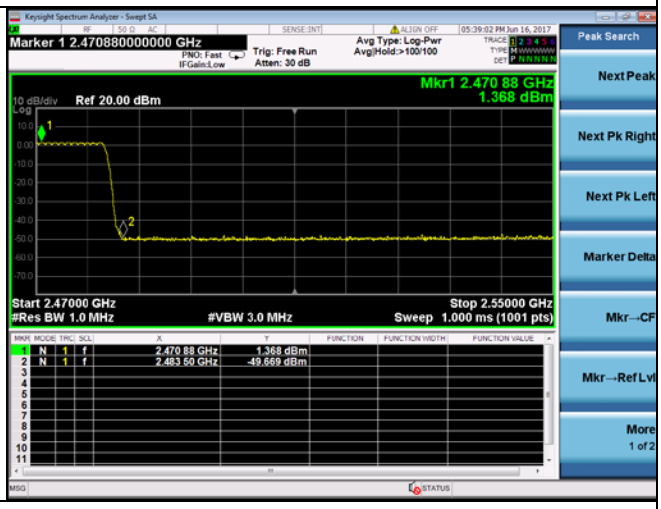
GFSK

Frequency (MHz)	Delta Peak to Band emission (dBc)	Hoping Mode	Limit (dBc)	Verdict
2400.00	-39.841	OFF	-20	PASS
2400.00	-39.306	ON	-20	PASS
2483.50	-52.628	OFF	-20	PASS
2483.50	-52.672	ON	-20	PASS

2402	2480
	
Hoping Off	Hoping Off
	
Hoping On	Hoping On

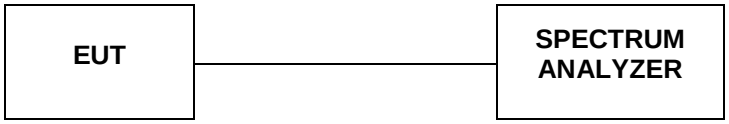
8DPSK

Frequency (MHz)	Delta Peak to Band emission (dBc)	Hoping Mode	Limit (dBc)	Verdict
2400.00	-29.702	OFF	-20	PASS
2400.00	-29.702	ON	-20	PASS
2483.50	-52.300	OFF	-20	PASS
2483.50	-51.037	ON	-20	PASS

2402	2480
	
Hoping Off	Hoping Off
	
Hoping On	Hoping On

4.7. Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and mwasure frequeny range from 9KHz to 25GHz.

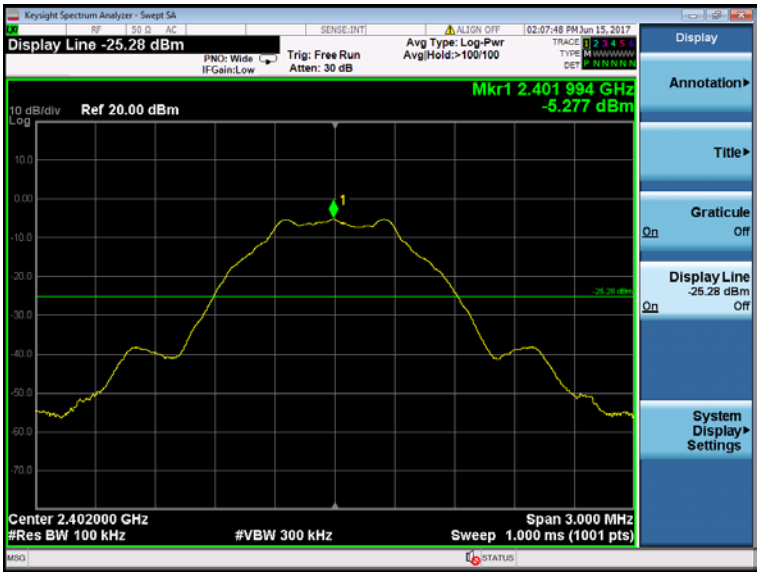
LIMIT

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.
3.For below 30MHz,For 9KHz-150kHz,150K-10MHz,We use the RBW 1KHz,10KHz, So the limit need to calculated by “10lg(BW1/BW2)“. for example For9KHz-150kHz,RBW 1KHz, The Limit= the highest emission level-20-10log(100/1)= the highest emission level-40.

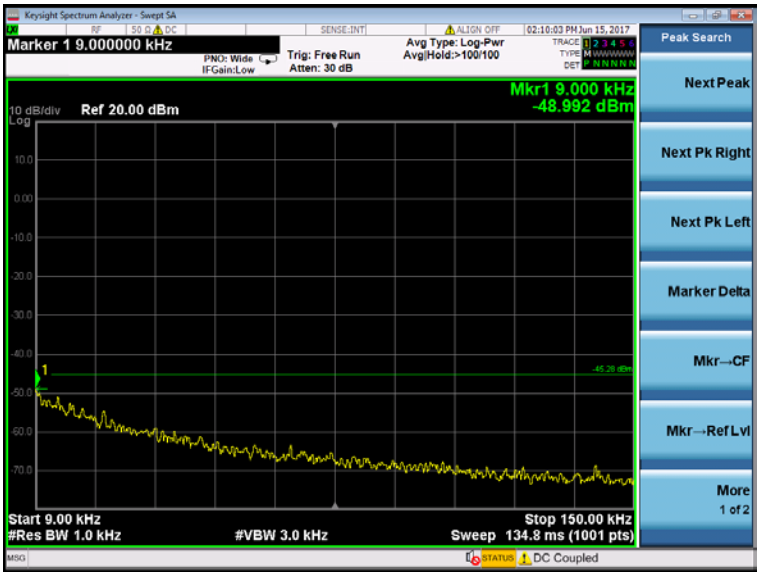
TEST RESULTS

Remark: The measurement frequency range is from 9KHz to the 10^{th} harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandege measurement data.

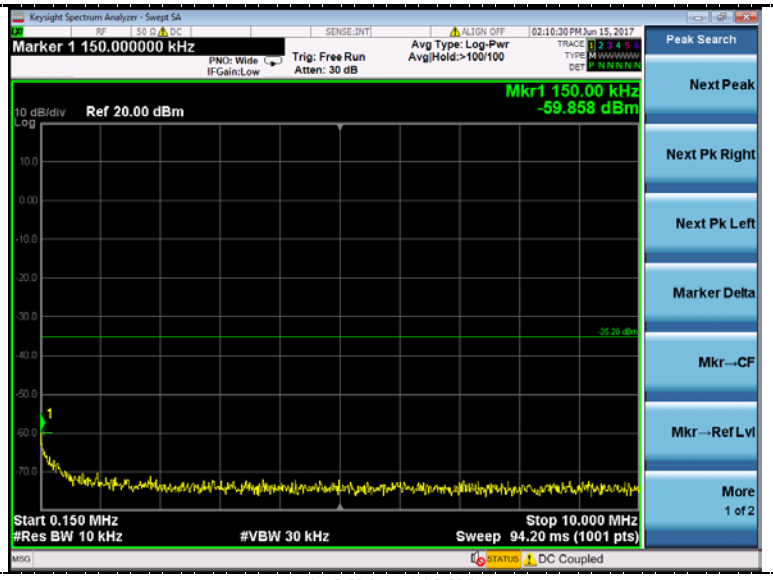
Test Mode:	GFSK	Test channel :	00



Channel 0

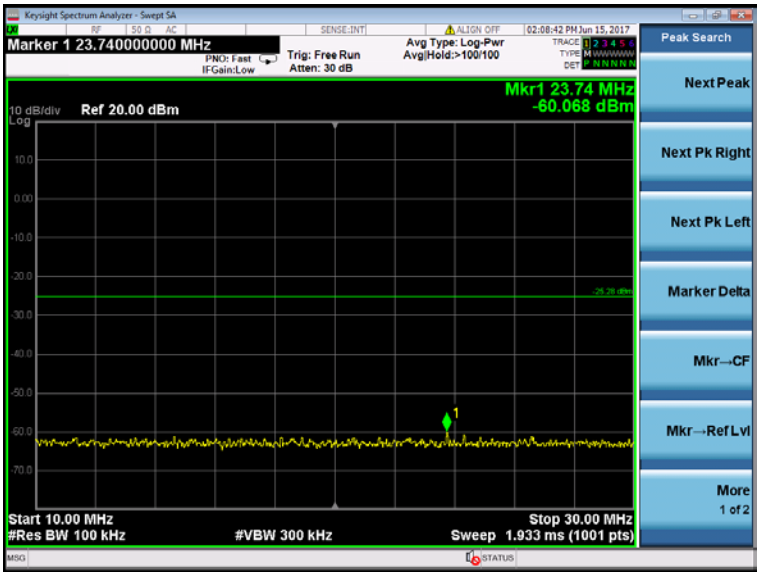


9KHz~0.15MHz



0.15MHz~10MHz

Test Mode:	GFSK	Test channel :	00

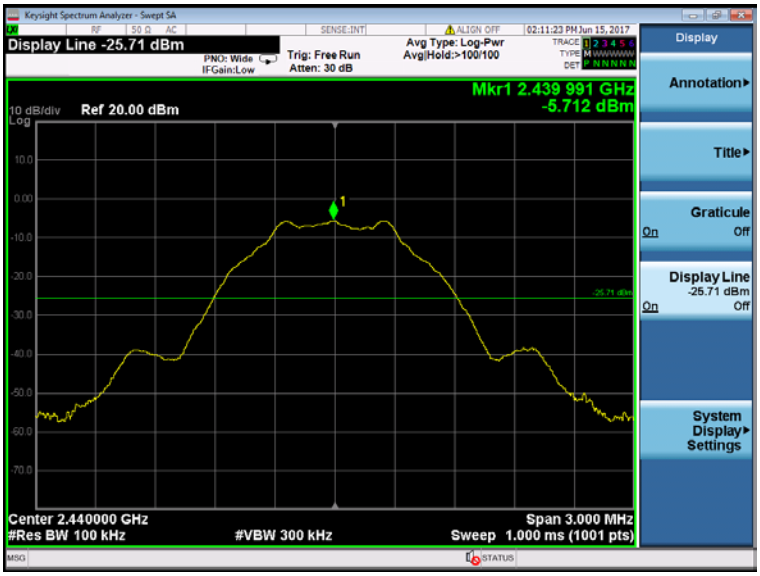


10MHz~30MHz

30MHz~3GHz

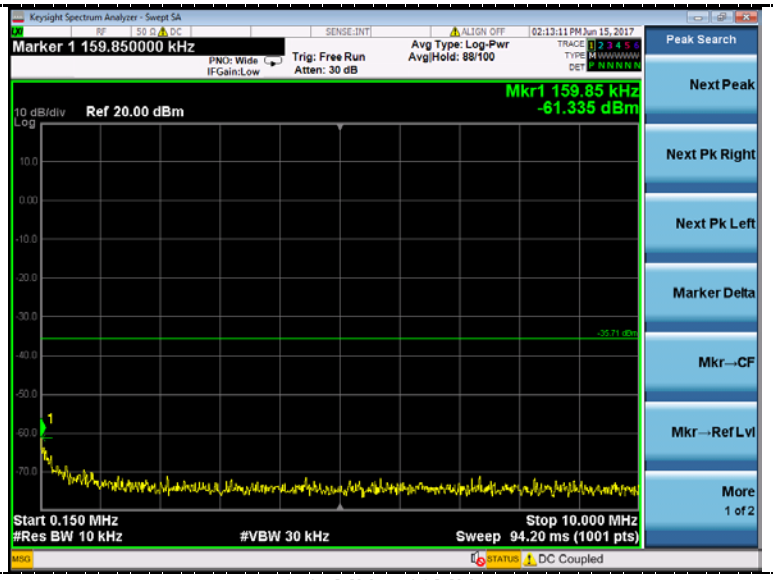
3GHz~25GHz

Test Mode:	GFSK	Test channel :	38



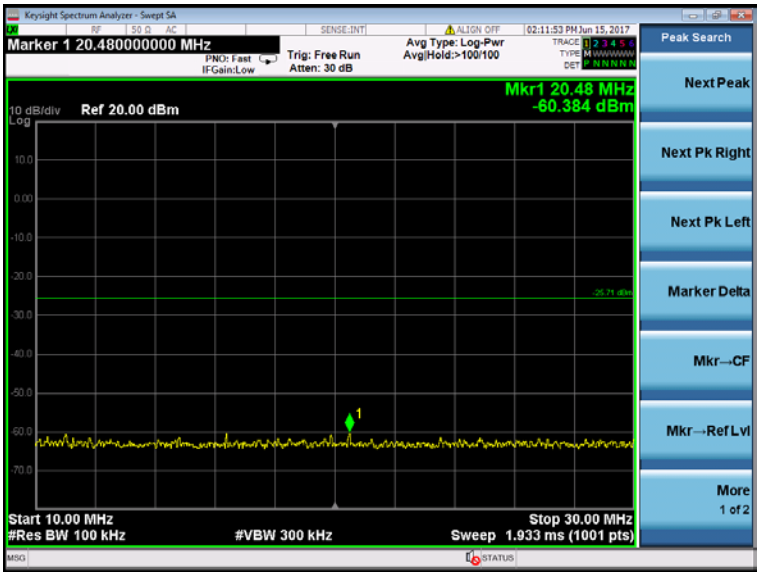
Channel 19

9KHz~0.15MHz

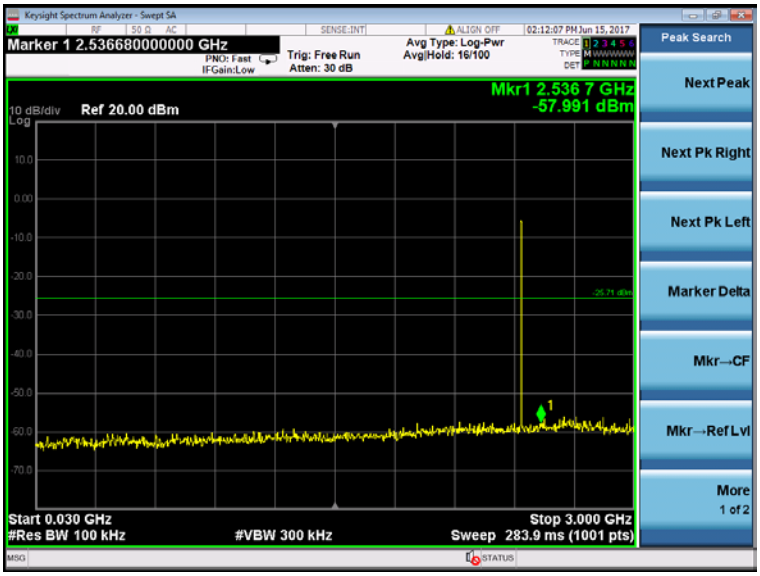


0.15MHz~10MHz

Test Mode:	GFSK	Test channel :	38



10MHz~30MHz



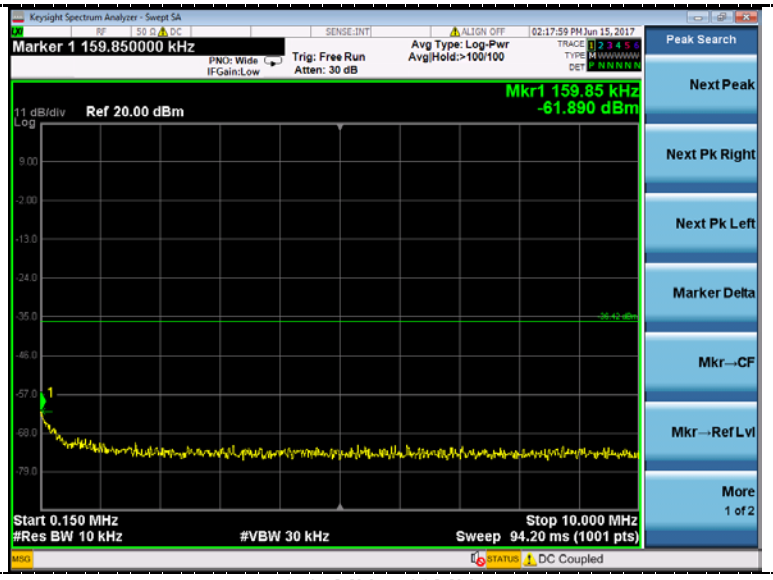
30MHz~3GHz

3GHz~25GHz

Test Mode:	GFSK	Test channel :	78

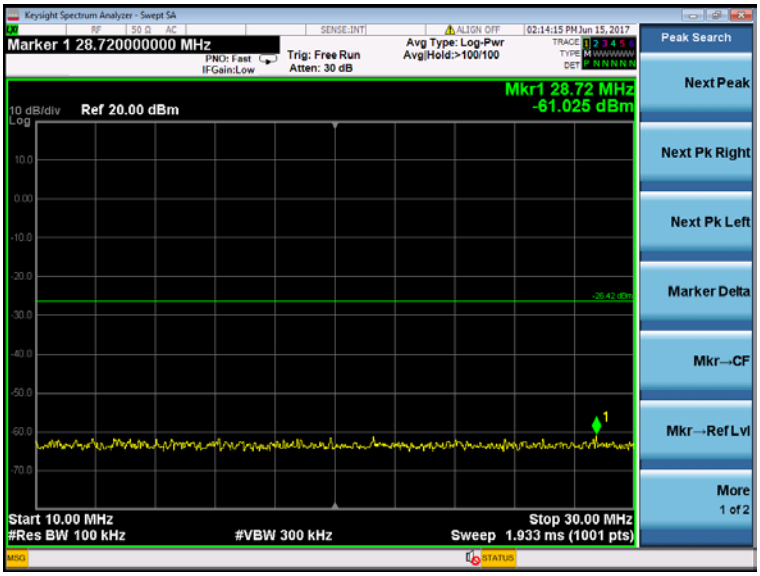
Channel 39

9KHz~0.15MHz

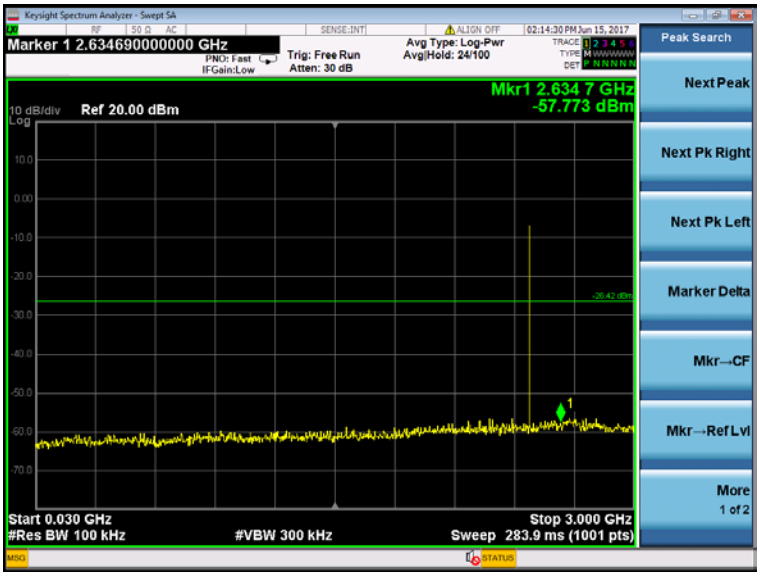


0.15MHz~10MHz

Test Mode:	GFSK	Test channel :	78



10MHz~30MHz

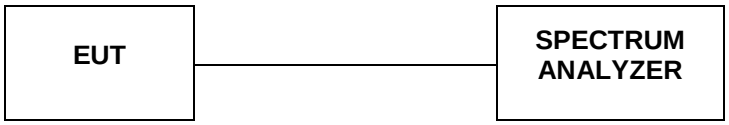


30MHz~3GHz

3GHz~25GHz

4.8. Number of hopping frequency

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator.Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=1MHz and VBW=3MHz.

LIMIT

Frequency hopping systems in the 2400–2483.5MHz band shall use at least 15 channels.

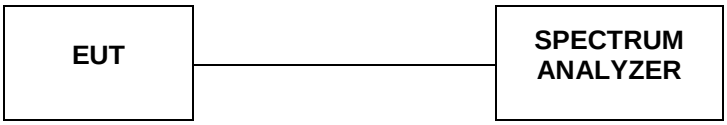
Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
8DPSK	79		

GFSK Modulation

8DPSK Modulation

4.9. Time Of Occupancy(Dwell Time)

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz,Span=0Hz.

LIMIT

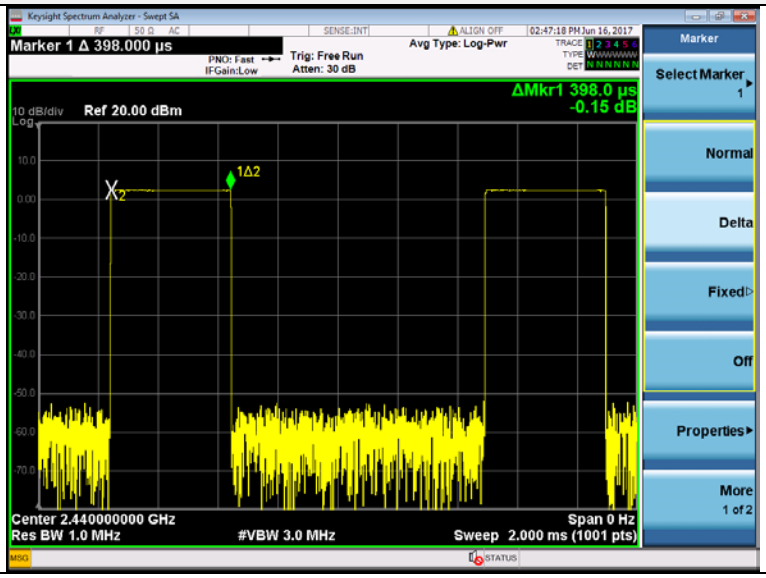
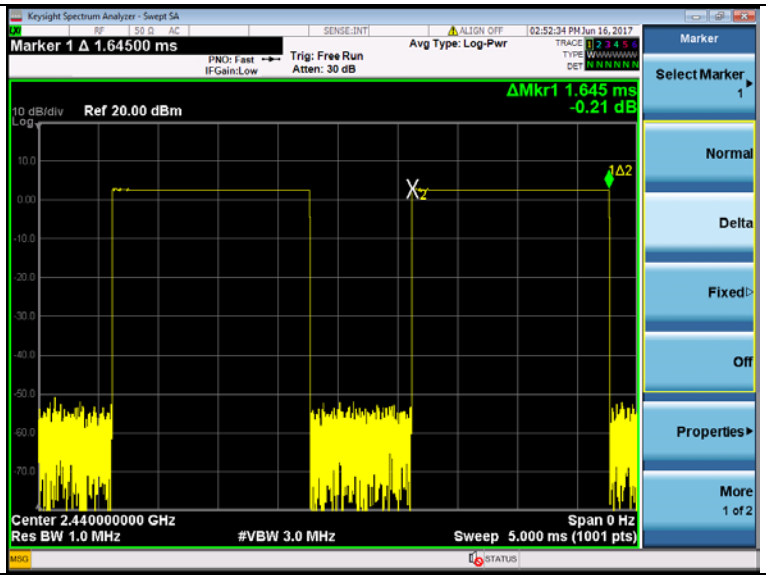
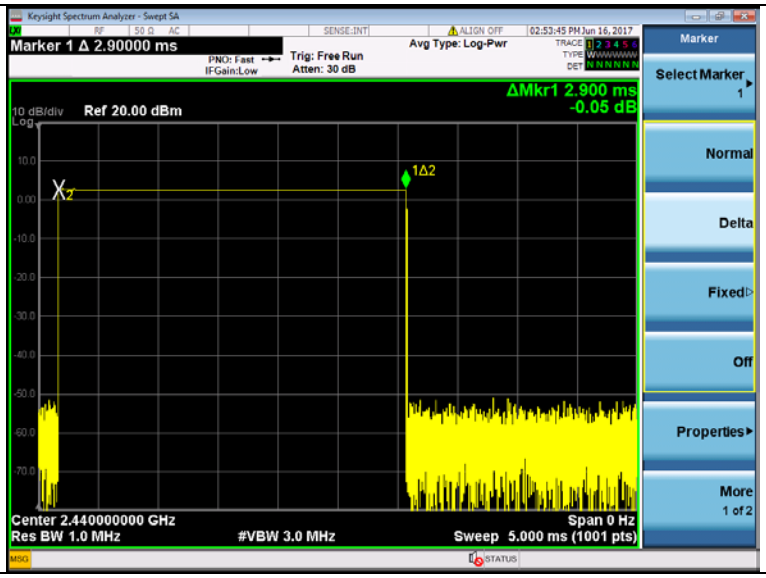
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a pe-riod of 0.4 seconds multiplied by the number of hopping channels employed.

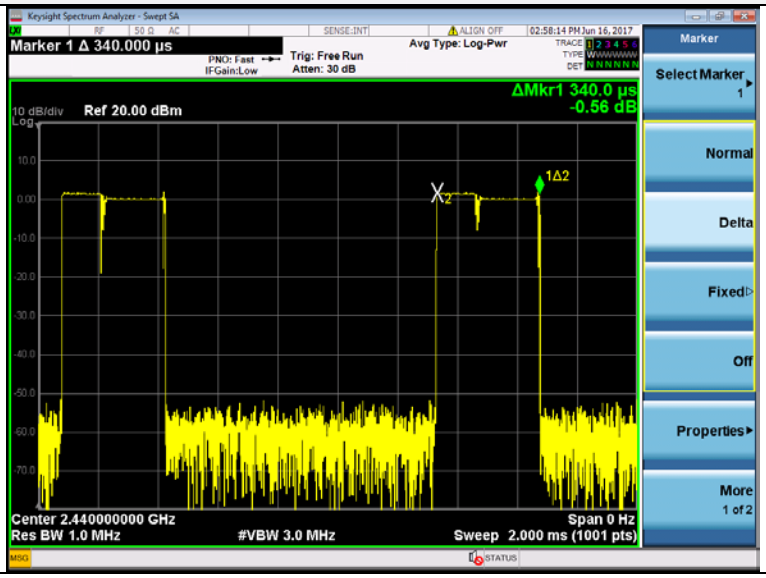
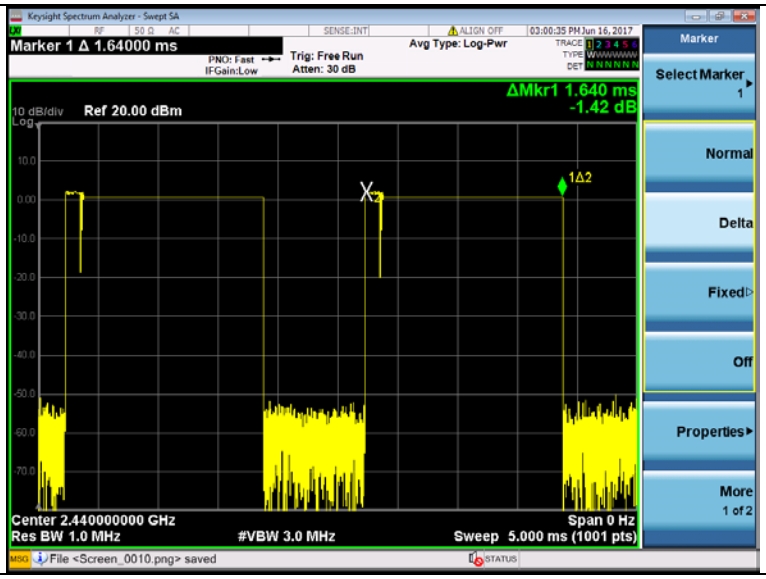
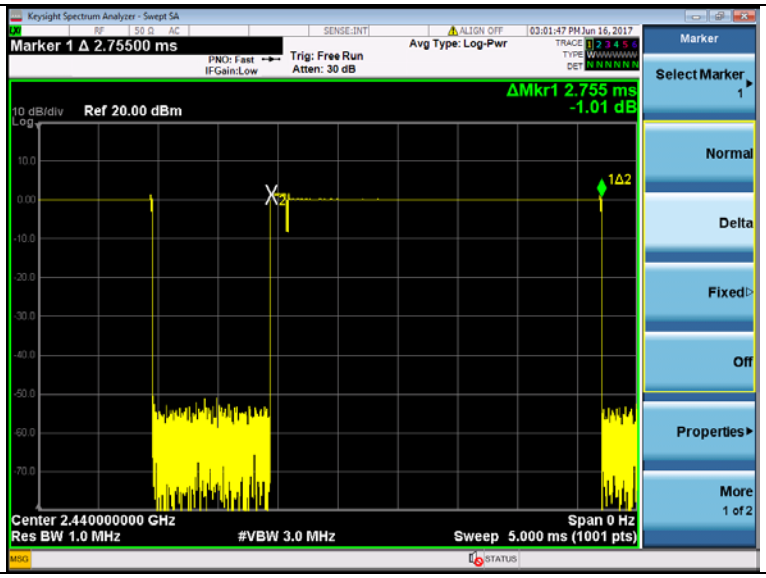
TEST RESULTS

Modulation	Packet	Pulse time (ms)	Dwell time (second)	Limit (second)	Result
GFSK	DH1	0.398	0.127	0.40	Pass
	DH3	1.645	0.263		
	DH5	2.900	0.309		
8DSPSK	3-DH1	0.340	0.109	0.40	Pass
	3-DH3	1.640	0.262		
	3-DH5	2.755	0.294		

Note:

1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1
   Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3, 3-DH3
   Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5, 3-DH5

GFSK Modulation

DH1

DH3

DH5

8DSPSK Modulation

3-DH1

3-DH3

3-DH5

4.10. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

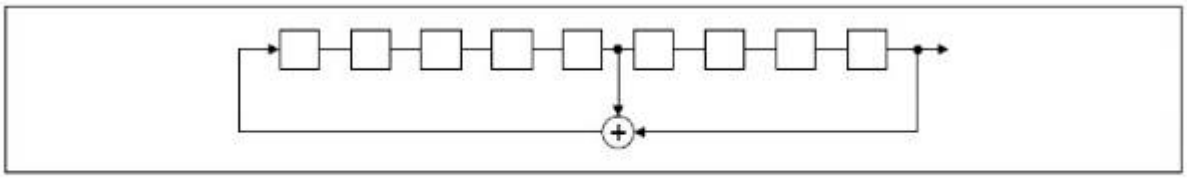
For 47 CFR Part 15C section 15.247 (a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier fre-quencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Al-ternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier fre-quencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to chan-nel frequencies that are selected at the system hopping rate from a pseudo ran-domly ordered list of hopping fre-quencies. Each frequency must be used equally on the average by each trans-mitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their cor-responding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

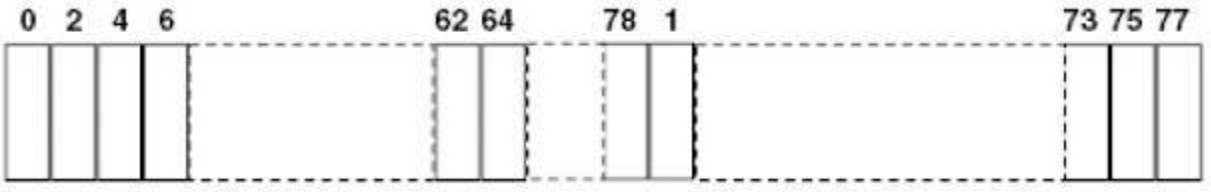
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage.And the result is fed back to the input of the frist stage.The sequence begins with the frist one of 9 consecutive ones,for example:the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An explame of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

4.11. Antenna Requirement

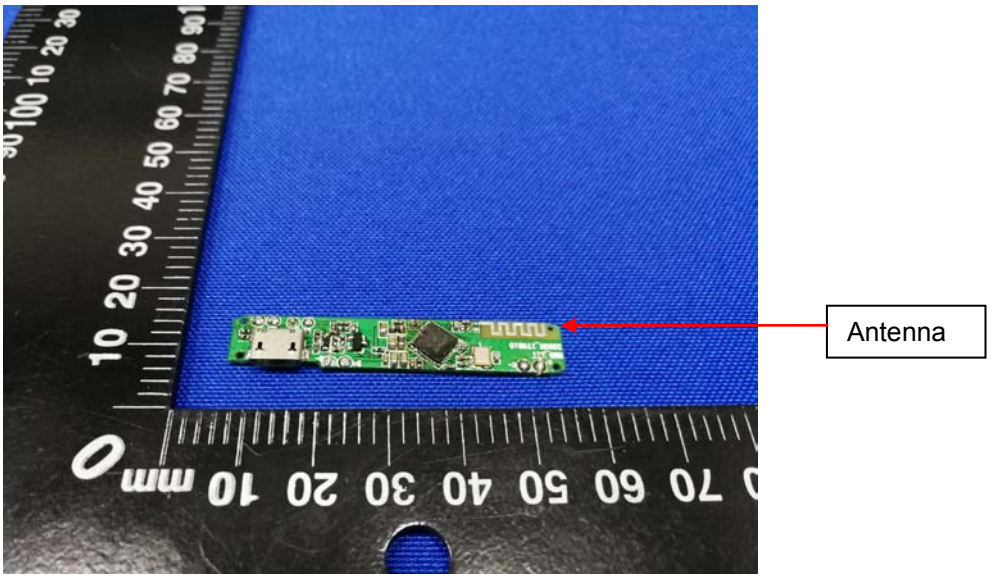
Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Antenna Information

The antenna is layout on PCB board, The directional gains of antenna used for transmitting is -0.64dBi.

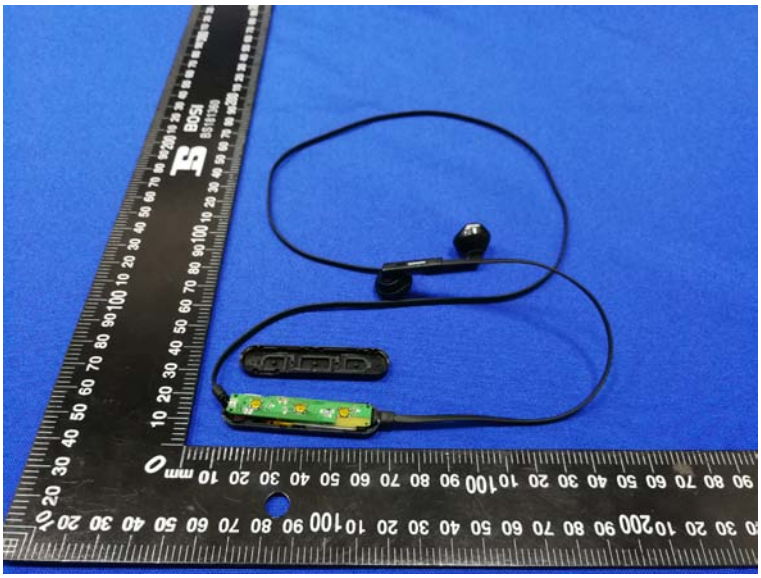


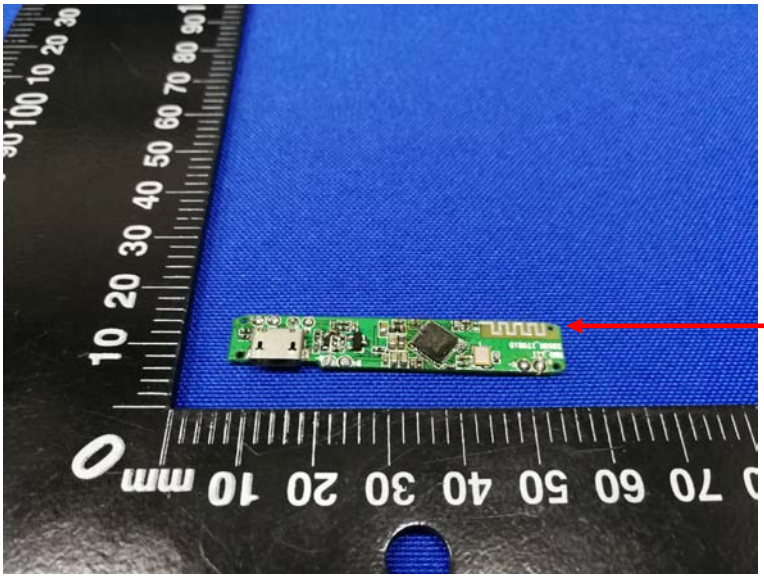
5. Test Setup Photos of the EUT

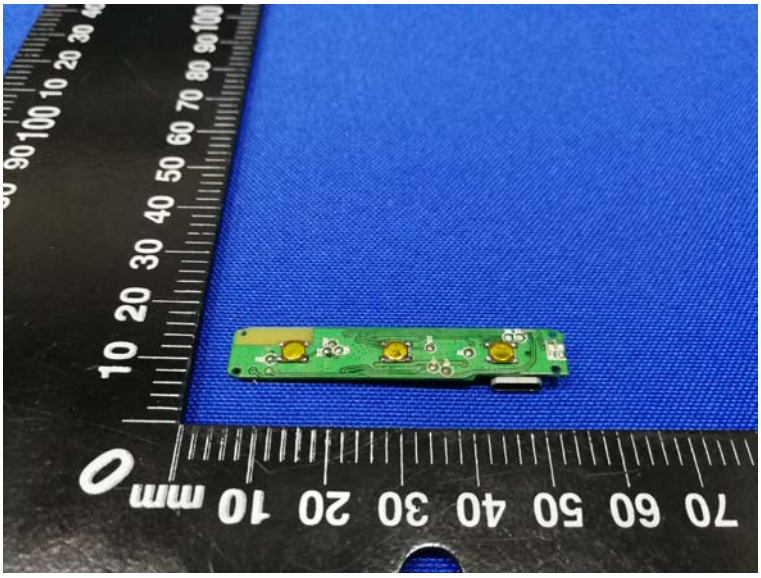
6. External and Internal Photos of the EUT

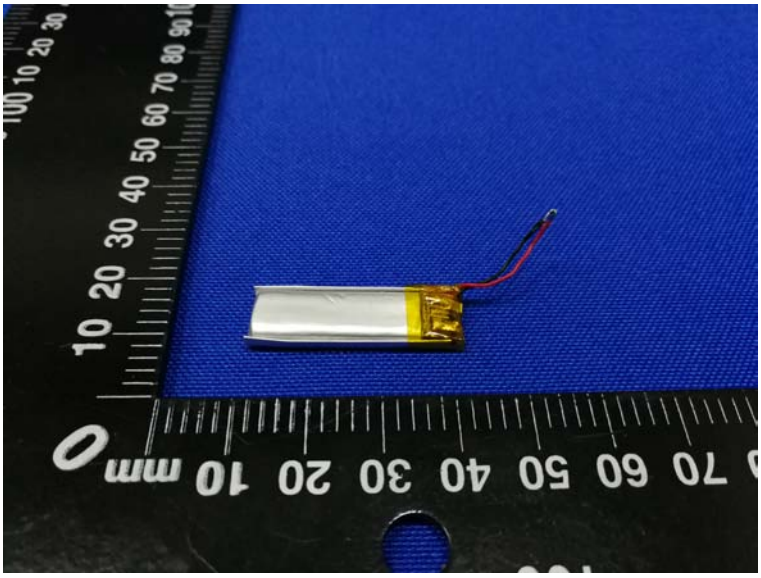
External Photos

Internal Photos









.....End of Report.....